

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Expanding Flexible Use in Mid-band Spectrum)	GN Docket No. 17-183
Between 3.7 and 24 GHz)	
)	

To: The Commission

COMMENTS OF HUAWEI TECHNOLOGIES CO., LTD.

Huawei Technologies Co., Ltd, (hereinafter “Huawei”)¹ respectfully submits these comments in response to the *Notice of Inquiry* (“NOI”) in the above-captioned proceeding in which the Federal Communications Commission (“FCC” or the “Commission”) seeks comment on potential opportunities for additional flexible access—particularly for wireless broadband services such as “5G”—in spectrum bands between 3.7 and 24 GHz (“mid-band spectrum”).²

Huawei commends the Commission for commencing this inquiry to explore options for expanded flexible wireless broadband use in mid-band frequencies in recognition of industry interests, research and testing activities, international considerations and the appeal made at an early stage of the *Spectrum Frontiers* proceeding from within the Commission itself to “look

¹ Huawei Technologies Co., Ltd. is a leading global information and communications technology (“ICT”) solutions provider. Huawei’s ICT solutions, products, and services are used in more than 170 countries and regions—including in North America—serving over one-third of the world’s population, enabling the future information society, and building a Better Connected World. See <http://www.huawei.com/en/>.

² See *In the Matter of Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz*, Notice of Inquiry, GN Docket No. 17-183, (rel. August. 3, 2017) (“NOI”). See also Statement of Commissioner Mignon L. Clyburn, NOI at 18 (“mid-band spectrum is not just important, but instrumental to unleashing the promise of 5G and beyond.”); Statement of Michael O’Reilly, NOI at 19 (“the U.S. wireless industry has identified [the 3.7-4.2 GHz band] for 5G given its underutilization by incumbent licensees”).

even further and target additional bandwidth between 6 and 24 GHz and even in lower bands.”³

Building on our comments submitted in the *Spectrum Frontiers* proceeding,⁴ Huawei appreciates the opportunity to share with the Commission our views and experiences related to the suitability of the 3.7-4.2 GHz band and the 5.925-7.125 GHz (“6 GHz”) band for expanded flexible wireless broadband use.

Huawei believes this NOI represents a further critical step in facilitating innovation and investment in future wireless technologies and services through the identification of spectrum bands with service goals that include 5G systems.⁵ As “one of our nation’s most precious resources,”⁶ access to additional spectrum bands is both “a critical input in the provision of mobile wireless services,”⁷ “crucial to promoting consumer choice and competition” and “foster[ing] innovation in the marketplace.”⁸ Access to additional spectrum bands also enables wireless providers to deploy next generation networks utilizing “a mix of particular spectrum bands” that feature diverse “engineering properties and deployment capabilities.”⁹

³ See Statement of Commissioner Michael O’Reilly Approving in Part, Dissenting in Part, *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, et al., Notice of Proposed Rulemaking, 30 FCC Rcd 11,878, 12,014 (2015) (“*Spectrum Frontiers NPRM*”).

⁴ See Huawei Comments, *Spectrum Frontiers NPRM*, GN Docket No. 14-177, RM 11664 (filed Jan. 28, 2016) (“Huawei Comments”).

⁵ See *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, et al., Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8020 (2016) (“*Spectrum Frontiers R&O & FNPRM*”) (noting that mmW bands are central to the variety of ideas and technological developments associated with the advent of fifth generation mobile wireless technology).

⁶ See *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 3961 (2015).

⁷ See *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, WT Docket 17-69, Twentieth Report (Rel. Sept. 27, 2017) at ¶ 35.

⁸ See *Policies Regarding Mobile Spectrum Holdings; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, WT Docket No. 12-269, GN Docket No. 12-268, Report and Order, 29 FCC Rcd 6133, 6156-6167 (*Mobile Spectrum Holdings Report and Order*), recon. denied, Order on Reconsideration, 30 FCC Rcd 8635 (2015) (*Mobile Spectrum Holdings Reconsideration Order*).

⁹ See *Id.*

Indeed, as the Commission has recognized, “explor[ation] of new opportunities for flexible broadband use in mid-band frequencies,” such as the 3.7-4.2 GHz band, is vital given the “combination of favorable propagation characteristics” and “additional channel bandwidth”¹⁰ for network deployments over medium distances, including coverage in streets and urban canyons.

These comments primarily focus on the 3.7-4.2 GHz band proposed by the Commission to be authorized for expanded flexible wireless broadband use. Specifically, based on our experience engineering 5G systems and trials with partner wireless service providers around the world, Huawei agrees with the proposal to extend opportunities for wireless broadband deployments in the 3.7-4.2 GHz band. Huawei views the extension of 5G services to the 3.7-4.2 GHz band to be particularly advantageous in light of the commonality with services being adopted for this band internationally (e.g., European Union-Germany, Japan, South Korea, and China).¹¹ Such global harmonization not only enables consumers to benefit from economies-of-scale in the manufacture of devices, but it also provides consumers with convenient global roaming services.

I. THE 3.7-4.2 GHz BAND

Huawei agrees with and supports the Commission’s proposal to consider the potential for more intensive use of the 3.7-4.2 GHz band for wireless broadband including fixed and mobile services. Huawei believes the existing service rules governing Geostationary orbit (“GSO”) Fixed Satellite Service (“FSS”) and terrestrial Fixed Service (“FS”) can be modified to further

¹⁰ See NOI at ¶ 6.

¹¹ See NOI, Statement of Commissioner Michael O’Reilly, at 19. See also *The Case for 5G Spectrum*, Global Mobile Suppliers Association, at 17 (Nov. 2016) (summarizing 5G spectrum announcements and preparations as of the publication date); and Letter of Sen. John Thune, Chairman of the Senate Committee on Commerce, Science and Transportation to FCC Chairman Ajit Pai (June 21, 2017), available at: https://www.commerce.senate.gov/public/_cache/files/3cefb171-0d50-4c23-9f31-48942e874cc6/4CAB0C0B754962807BB0C203E951D581.thune-letter-on-mid-band-spectrum.pdf.

promote use in this band, as well as to stimulate investment and encourage more intensive deployment for wireless broadband.¹²

Huawei believes that access to suitable spectrum is key to enabling the adoption of future broadband wireless services. This includes services featuring high throughput, coupled with low latency of 1 millisecond or less. In addition, Huawei notes that industry standard common radio band plans and equipment standards are being developed to ensure compatibility of wireless network equipment, user terminals and services across this band. As deployment of 5G systems requires a stable environment for both customers and wireless network operators, ensuring such stability may be realized through longer license terms, larger geographic areas, and an expectancy of license renewal.

Further, Huawei's comments in the *Spectrum Frontiers* proceeding emphasized the beneficial effects of interoperability across geographic regions and economies-of-scale in equipment manufacturing achieved through globally harmonized spectrum bands.¹³ Huawei wholeheartedly endorses the views that global harmonization "bring[s] the potential for scale economies that will lower the cost of equipment and deployment," which will increase "the speed of availability of 5G services both on our shores and worldwide."¹⁴ In this respect, Huawei notes that the 3.7-4.2 GHz band is allocated for primary mobile use in the tables of the International Telecommunications Union ("ITU"). Consequently, Huawei encourages the FCC to take an innovative view in providing rules and licensing terms that would enable 5G mobile services in this band.

In light of these and other characteristics of the 3.7-4.2 GHz band, Huawei believes that

¹² See NOI at ¶ 16.

¹³ See Huawei Comments at 15.

¹⁴ See Statement of Commissioner Jessica Rosenworcel, *Spectrum Frontiers* NPRM, at 12010 (2015).

more use of the band for wireless broadband is an important element for the establishment of the highest performing 5G networks globally, supporting both the development of a vibrant device eco-system and the cost-effective evolution of mobile networks from existing 4G technologies to new air interfaces.

A. Industry Trials of Flexible Use in the 3.7-4.2 GHz Bands

In conjunction with major wireless network operators globally, Huawei has conducted, and is in the process of conducting, 5G network field trials in and adjacent to the 3.5 GHz band. These trials have proved the feasibility of wireless broadband operations in these bands and achieved desired technical and user performance results.

For example, earlier this year, Huawei and Softbank completed massive-MIMO verification testing for commercial deployment in Tokyo, Japan, using 40 MHz of spectrum in the 3.5 GHz band.¹⁵ The test delivered a peak download rate of more than 1 Gbps, reflecting the inherent potential of 3.5 GHz spectrum in opening a new commercial era in mobile networks. In addition, Huawei completed form-factor field tests of wide-bandwidth 5G user handsets using 3.5 GHz spectrum as a part of the second phase of China IMT-2020 5G tests led by the China Academy of Information and Communication Technology (“CAICT”).¹⁶ The 5G terminal prototype – which supported a bandwidth of 200 MHz – was configured with a miniature multi-element antenna to transmit and receive RF signals with eight radio frequency transceivers and built using a software-defined baseband. The test terminal was constructed in compliance with air interface parameters in the 3GPP’s New Radio (“NR”) standard. These trials were conducted

¹⁵ See Press Release, Huawei Technologies Co. Ltd., Huawei Completed the World’s First 3.5 GHz Massive MIMO with CA Test, Further Mining the Value of 3.5 GHz Ultra-Wide Spectrum (Feb. 24, 2017), <http://www.huawei.com/en/news/2017/2/World-First-3dot5GHz-Massive-MIMO-CA-Test>.

¹⁶ See Press Release, Huawei Technologies Co., Ltd., Huawei Completes Core Network Test for Second-Phase of 5G R&D Trial Under IMT-2020 (5G) Promotion Group (Sept. 21, 2017), <http://www.huawei.com/en/news/2017/9/Huawei-Core-Network-Test-IMT-2020-5G>.

in Beijing, China using 23 fixed and mobile terminals and a 5G macro-cell base station operating in the 3.5 GHz band supporting 64 radio frequency transceivers and 24 MIMO data streams.

With the cooperation of service provider China Mobile, Huawei also recently demonstrated augmented reality and virtual reality applications bringing together sub-6 GHz and millimeter wave (“mmW”) spectrum simultaneously. These tests delivered 22 Gbps throughput with less than 0.5 millisecond of latency to the end users. This demonstration showed how “5G Dual Connectivity” using spectrum in the 3.5 GHz band and channels in the Ka band (i.e., in the 26.5-40 GHz range) can be combined for high throughput services.¹⁷ Separately, Huawei and NTT DOCOMO) partnered in October 2016 to conduct a large-scale outdoor data-transmission trial in a field measuring 100,000 square meters (equivalent to 12 soccer fields) in the Minato Mirai 21 waterfront of Yokohama, Japan.¹⁸ Using 23 simultaneously connected mobile devices, the test achieved a cumulative 11.29 Gbps of data throughput and latency below 0.5 milliseconds using the 4.5 GHz frequency band.

Huawei has also participated in the field performance tests of 5G New Radio (“NR”) technology in the 3.5 GHz band as part of the second phase of 5G trials in China led by the IMT-2020 (5G) Promotion Group. The field tests began when an IMT-2020 (5G)-led testing group established a 5G trial zone in Beijing in late December 2016 following the release of the Promotion Group's requirements for the second phase of 5G trials.¹⁹ The field tests checked the

¹⁷ See Press Release, Huawei Technologies Co., Ltd., Huawei and China Mobile Joint Innovation of 5G Sub-6GHz & mmWave Frequency Band Cooperation Technology (Feb. 27, 2017), <http://www.huawei.com/en/news/2017/2/Huawei-China-Mobile-Joint-Innovation-5G>.

¹⁸ See Press Release, Huawei Technologies Co., Ltd., Huawei and DOCOMO Conduct World's First 5G Large Scale Field Trial in the 4.5 GHz Band (Nov. 16, 2016), <http://www.huawei.com/en/news/2016/11/World-First-5G-Large-Scale-Field-Trial>.

¹⁹ See Press Release, Huawei Technologies Co., Ltd., Huawei Leads the Way to 5G in China with Successful Field Performance Testing (February 23, 2017); <http://www.huawei.com/en/news/2017/2/Huawei-Leads-the-Way-5G->

performance against technical requirements and interoperability with the equipment, instruments, and chips of manufacturers across the industry. The performance tests verified the system's parameter sets, frame structures, and new waveform technologies for compliance with current 3GPP NR specifications for the 5G New Radio at 3.4-3.6 GHz and 4.8-5.0 GHz bands, respectively. Three major scenarios defined by ITU-R – enhanced Mobile Broadband (“eMBB”); Ultra Low Latency and Reliable Communications (“URLLC”); and massive Machine-Type Communications (“mMTC”) – were tested. The recent large scale field trial results demonstrated the downlink sector peak throughput of 32 Gbps and uplink peak sector throughput of 20 Gbps for eMBB scenario and 0.33 ms radio interface latency for URLLC scenario and more than 10 million links for short machine type packet per hour, achieving the ITU performance specifications of 10 Gbps throughput for over 1 million simultaneous connections with air interface latency under 1 millisecond.

More recently, in September 2017, Huawei collaborated with Deutsche Telekom Group in successfully testing 5G New Radio pre-commercial equipment in field environments based on the latest 3GPP R15 standards using a 3.7 GHz band radio system.²⁰ This live real-world setting in central Berlin, Germany has shown a 5G connection at over 2 Gbps with an end-to-end low latency of 3 milliseconds.

Huawei believes that these system trials and demonstrations show the performance benefits of 5G systems including high density, high throughput traffic and tight focusing of spectrum usage (i.e., low spectrum spillover). The 3.7-4.2 GHz band, under appropriate rules

China. The testing group included China Academy of Information and Communications Technology (CAICT), China Mobile, China Unicom, China Telecom and NTT DOCOMO Beijing Labs.

²⁰ See Press Release, Deutsche Telekom Group, DT and Huawei Go Live with Europe's First 5G Connection (Sept. 1, 2017), <https://www.telekom.com/en/media/media-information/archive/dt-and-huawei-go-live-with-europes-first-5g-connection-501660>.

and licensing terms, is well suited to these high capability mobile communications services.

B. Spectrum Coordination

Huawei encourages and participates in global industry efforts to harmonize the 3.7-4.2 GHz band in order to enable its usage for 5G deployments. Huawei believes this band is ideally suited for licensed commercial services and, in all respects, has characteristics most favorable for future anticipated 5G applications.

Absent meaningful incentives for incumbents to relinquish the spectrum, however, Huawei acknowledges that flexible broadband wireless services in the 3.7-4.2 GHz band must co-exist with FSS incumbents. In that regard, Huawei encourages further examination of the options recommended by stakeholders in this proceeding as the most effective opportunities for entrant license holders to fully realize the band's 5G potential while also protecting incumbent services. The means adopted, however, should be devoid of unnecessary delays associated with the deployment or retooling of complex sharing protocols while minimizing the potential for harmful interference among services that will be sharing the band.

C. Global Band Harmonization

Huawei is working to ensure that global standards are harmonized for this band in order to ensure better ecosystem support and extensive user services. The 3.7-4.2 GHz band is attractive due to its favorable propagation characteristics; with the feasibility of radio-transceiver/antenna tunability, 3.7-4.2 GHz becomes a prime candidate for global harmonization in light of the consideration given to the 3.5 GHz and 4 GHz ranges in Europe, Japan, South Korea and China.

There is considerable opportunity for global commonality of spectrum in these bands. Such commonality will enable beneficial services to U.S. consumers through global

interoperability roaming, and market opportunities for U.S. industry stakeholders to sell products and services outside the United States. Huawei continues to encourage the global harmonization for this band to ensure wide ecosystem support.

II. THE 6 GHZ BAND

Huawei thanks the Commission for opening discussions on the potential use of the 5.925-6.425 GHz band (“lower 6 GHz”) and the 6.425-7.125 GHz band (“upper 6 GHz”) for flexible wireless broadband use.²¹ Huawei agrees with the Commission that the close proximity of the lower 6 GHz’s spectrum to the already designated Unlicensed National Information Infrastructure (“U-NII”) spectrum creates advantages and benefits by expanding U-NII operations into this lower 6 GHz band. Huawei also recognizes, however, the heavy use of the lower 6 GHz band for FS, including critical services such as public safety.²² New types of services introduced into these bands will, consequently, require proper protection for licensed incumbent operators.

To determine the mechanisms best suited for fulfilling the needs of incumbents in the band, while also offering opportunities for flexible use to potential entrants, the Commission should encourage a multi-stakeholder review, with the participation of all interested stakeholders, to study the feasibility of the potential technical solutions cited in the NOI (as well as possibly others) and then to determine the best sharing technique going forward. Such studies are currently underway in the European Telecommunications Standards Institute (“ETSI”)

²¹ See NOI at ¶ 24-36.

²² See *Id.* at ¶ 25.

Broadband Radio Access Network (“BRAN”)²³ and upon completion may bring needed insights into the sharing of the band with other potential users.

In terms of dynamic frequency selection (“DFS”) and the Commission’s observation of its use, or lack thereof,²⁴ Huawei encourages the Commission to recognize the work of the Wi-Fi Alliance and its members to ascertain a better understanding of the challenges associated with the use of DFS spectrum. In addition to the protracted and costly type-approval process, technical complexities also create hesitancy in fully incorporating the band into product solutions. Until industry has a better understanding of these issues, Huawei supports the Commission’s view to maintain relevant DFS rules at this time.

III. CONCLUSION

Huawei views the extension of 5G technologies and services to the 3.7-4.2 GHz band to be a significant beneficial opportunity in developing the next generation of wireless infrastructure and services. 5G is an exciting new innovation in the ICT industry, designed to enable a super-connected, intelligent digital world. The future of 5G is dependent on a variety of factors; global spectrum availability is a fundamental prerequisite to investment and ongoing development of technologies and network architectures that will enable 5G services. This includes cross-industry collaboration in standards development, establishment of pilot networks to demonstrate capabilities and interoperability of new deployments. The commonality of this spectrum band with global usage is particularly advantageous to consumers and manufacturers in the United States as a result of global economies of scale and global service availability.

²³ See ETSI BRAN for standardization: *DRAFT ETSI TR 103 524 V0.0.2 (2017-06), Wireless access systems including radio local area networks (WAS/RLANs) in the band 5925 - 6425 [6725] MHz*.

²⁴ See NOI at ¶ 30.

Huawei thanks the Commission for its early recognition of, and action on, the 3.7-4.2 GHz band and hopes these comments will help facilitate the Commission's efforts in realizing the possibilities of future networks and services. Huawei continues to stand ready to clarify and/or supplement these comments as may be helpful to achieving the Commission's goals and looks forward to the Commission's next steps in releasing a *Notice of Proposed Rulemaking* ("NPRM").

Respectfully submitted,

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